PTO 07-[0426]

Japanese Patent

Hei 9-136807

MATERIAL FOR FEEDING IRON TO CROP PLANTS

[Sakumotsu Ni Tetsu O Kokyusuru Shizai]

Kiyobumi Takahashi and Yasuo Iioi

UNITED STATES PATENT AND TRADEMARK OFFICE

Washington, D.C. November 2006

Translated by: Schreiber Translations, Inc.

Country : Japan

Document No. : Hei 9-136807

Document Type : Kokai

Language : Japanese

Inventor : Kiyobumi Takahashi and Yasuo Iioi

Applicant : Nitto Chemical Industry Co., Ltd.
Tomoe Kagaku Kogyo K.K.

IPC : A 01 N 59/16, A 01 G 7/00, C 05 D 9/02, C 07 C 229/76, C 07 F 15/02

Application Date : November 14, 1995

Publication Date : May 27, 1997

Foreign Language Title : Sakumotsu Ni Tetsu O Kokyusuru Shizai

English Title : MATERIAL FOR FEEDING IRON TO CROP PLANTS

Specification

1. Title of the invention

Material for Feeding Iron to Corp Plants

2. Claims

1. A material for feeding iron to crop plants, characterized by the fact that a biodegradable iron chelate compound is included as an active ingredient.

2. The material for feeding iron to crop plants of Claim 1, characterized by the fact that the biodegradable iron chelate compound is at least one kind selected from iron chelate compounds of aspartic acid-N-monoacetic acid, aspartic acid-N-monopropionic acid, aspartic acid-N,N-diacetic acid, glutamic acid-N,N-diacetic acid, iminodisuccinic acid, ethylenediamine-N,N'-disuccinic acid, propanediamine-N,N'-disuccinic acid, taurinediacetic acid, and N-methyliminodiacetic acid.

3. The material for feeding iron to crop plants of Claim 1, characterized by the fact that the biodegradable iron chelate compound is at least one kind selected from iron chelate compounds of (S)-aspartic acid-N-monoacetic acid, (S)-aspartic

---

[1] Numbers in the margin indicate pagination in the foreign text.

acid-N-monopropionic acid, (S)-aspartic acid-N,N-diacetic acid, (S)-glutamic acid-N,N-diacetic acid, (S,S)-iminodisuccinic acid, (R,S)-iminodisuccinic acid, (R,R)-iminodisuccinic acid, (S,S)-ethylenediamine-N,N′-disuccinic acid, (R,S)-ethylenediamine-N,N′-disuccinic acid, (R,R)-ethylenediamine-N,N′-disuccinic acid, (S,S)-propanediamine-N,N′-disuccinic acid, (R,S)-propanediamine-N,N′-disuccinic acid, and (R,R)-propanediamine-N,N′-disuccinic acid.

3. Detailed explanation of the invention

[0001]

(Technical field of the invention)

The present invention pertains to a material for feeding iron to crop plants. The material for feeding iron of the resent invention is directly applied to leaf surfaces, fruits, or seeds of agricultural and horticultural crop plants or used in the soil or its medium for cultivating crop plants, so that a required iron can be fed to the crop plants. Thereby, the iron-deficient disease of these agricultural and horticultural crop plants can be prevented and lightened. With the feed of the iron by the material for feeding iron of the present invention, the iron-deficient disease can be prevented and lightened, and the qualities of the agricultural and horticultural crop plants can be improved. Thus, the present invention is agriculturally very useful.

[0002]

(Prior art)

Various physiological damages due to the element deficiency of agricultural and horticultural crop plants have been known, and the importance of an infinitesimal amount of elements in the growth of crop plants has been indicated. It is known that iron has an important action in an energy transmission system, mainly in an oxidation-reduction reaction in vivo and is directly related to the biosynthesis path of a chlorophyll. If the iron is deficient, new leaves cause a chlorosis, turn out to be white, and if the leaves are held as they are, they are withered.

[0003] Currently, as a countermeasure to the iron-deficient disease in the agricultural and horticultural crop plants, inorganic iron compounds such as iron (I) sulfate or iron (II) chloride are sprayed on the leaf surfaces, however the effect is insufficient. Drug damages are also likely to be caused. On the contrary, spraying or soil-irrigating of a chelate iron such as iron ethylenediamine tetraacetate and iron nitrilotriacetate on the leaf surfaces is generally carried out since the fixture to the soil is little and the iron is easily absorbed.

[0004]

(Problems to be solved by the invention)

In the chelate iron such as iron ethylenediamine tetraacetate and iron nitrilotriacetate, even if the iron supply to crop plants is sufficient, the chelate compound such as ethylenediaminetetraacetic acid and nitrilotriacetic acid remains in the environment after the iron is absorbed. When the ethylenediaminetetracetic acid in the chelate compound is discharged into the environment, it traps and solubilizes harmful heavy metals in the environment are trapped. The generated heavy metal chelates are likely to contaminate underground water, etc. On the other hand, it is reported that the iron nitrilotriacetate itself is carcinogenic (Active Oxygen-Free Radical 3(3),376 (1992)), etc., and the feed of a material that can be substituted for the above-mentioned substances has been in demand.

[0005]

(Means to solve the problems)

These inventors researched the above problems in earnest, and as a result, it was discovered that the following compounds had good biodegradability, generated stable iron chelates, and could feed iron to crop plants. The present invention was completed. In other words, iron chelates of compounds such as aspartic acid-N-monoacetic acid, aspartic acid-N-monopropionic acid, aspartic acid-N,N-diacetic acid, glutamic acid-N,N-diacetic acid, iminodisuccinic acid, ethylenediamine-N,N′-disuccinic acid, propanediamine-N,N′-disuccinic acid, taurinediacetic acid, and N-methyliminodiacetic acid have biodegradability, are rapidly decomposed even if they are discharged into the environment, and do not chelate heavy metals in the environment. These biodegradable iron chelate compounds are directly applied to leaf surfaces, fruits, or seeds of agricultural and horticultural crop plants or used in the soil or its medium for cultivating crop plants, so that a required iron can be fed to the crop plants. Thereby, the iron-deficient disease of these agricultural and horticultural crop plants can be prevented and lightened, and the qualities of the agricultural and horticultural crop plants can be improved.

[0006] Since some of these iron chelate compounds have one or two asymmetric carbon atoms, the iron chelate compounds being used sometimes turn out to be a mixture of optical isomers. As the iron chelate compounds as the optical isomers, iron chelate compounds of (S)-aspartic acid-N-monoacetic acid, (S)-aspartic acid-N-monopropionic acid, (S)-aspartic acid-N,N-diacetic acid, (S)-glutamic acid-N,N-diacetic acid, (S,S)-iminodisuccinic acid, (R,S)-iminodisuccinic acid, (R,R)-iminodisuccinic acid, (S,S)-

ethylenediamine-N,N'-disuccinic acid, (R,S)-ethylenediamine-N,N'-disuccinic acid, (R,R)-ethylenediamine-N,N'-disuccinic acid, (S,S)-propanediamine-N,N'-disuccinic acid, /3 (R,S)-propanediamine-N,N'-disuccinic acid, and (R,R)-propanediamine-N,N'-disuccinic acid are included.

[0007] These biodegradable iron chelate compounds are agriculturally very useful materials for feeding iron, and the iron feed method using the biodegradable iron chelate compounds is an iron feed method that is environmentally excellent and replaces iron ethylenediamine tetraacetate and iron nitrilotriacetate.

[0008]

(Embodiment of the invention)

Next, the present invention is explained in detail. The biodegradable iron chelate compounds of the present invention can be manufactured by a method described in Japanese Kokai Patent Application No. Hei 7[1995]-2745, etc. In case these biodegradable chelate compounds are used as materials for feeding iron to crop plants, the iron chelate compounds can be directly applied to leaf surfaces, fruits, or seeds of agricultural and horticultural crop plants or used in the soil or its medium for cultivating crop plants. Also, these iron chelate compounds are diluted with water, etc., and can be directly applied to leaf surfaces, fruits, or seeds of agricultural and horticultural crop plants or applied to the soil or its medium for cultivating crop plants. Furthermore, these iron chelate compounds can also be used by applying them to optional formulations such as powder agents, hydrating agents, liquid agents, oil agents, emulsions, and spray agents by using appropriate solid carriers, liquid carriers, emulsified dispersants, etc., being used in agricultural chemical formulations. These iron chelate compounds can include inorganic salts, inorganic fertilizers, organic fertilizers, insecticides, herbicides, etc., or can use them in combination.

[0009] The method for feeding iron by using the material of the present invention can be applied to broad agricultural and horticultural crop plants. As detailed examples of the agricultural and horticultural crop plants, fruit trees such as oranges, apples, pears, peaches, grapes, chestnuts, figs, apricots, Japanese plums, ume trees, loquats, and pineapples, cucumber family plants such as cucumbers, melons, watermelons, and pumpkins, eggplant family plants such as green papers, tomatoes, and eggplants, fruits and vegetables such as strawberries, taproots such as beets, Japanese radishes, carrots, and burdocks, tuberous roots such as spikenards, potatoes, taros, yams, konjaks, lotus roots, and gingers, bean family plants such as soybeans, adzuki beans, green bean, peas, broad beans, and peanuts, cereals and forage crops such as rice plant, barley, wheat, rye, adlay, buckwheat, foxtail millet, Deccan grass, other coffees, sunflowers, rape oil, etc., are mentioned. These crop plants are only examples to which the present invention can be applied, and the present invention is not limited to these crop plants.

[0010] The material for feeding iron to crop plants of the present invention can be applied to various stages of the growth of crop plants. In the application, said compound may be applied to the soil in which crop plants grow or may also be directly applied to crop plants in seedling stage, blooming stage, and fruiting stage. The amount being used depends on the kind of crop plants being treated, specific crop plant parts or growth places to be applied, growth stage of crop plants, application methods, and other factors, and the amount is in a range of generally 0.001-100,000 ppm, preferably 0.01-10,000 ppm.

[0011]

(Application examples)

Next, the present invention is explained in detail by application examples, however the present invention is not limited to these application examples.

[0012] Application Example 1 (Preparation of iron ethylenediamine-N,N-disuccinate chelate liquid agent)

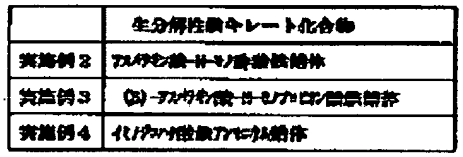
A liquid agent composed of 10 parts iron ethylenediamine-N,N-disuccinate·ammonium complex and 90 parts water was obtained.

[0013] Application Examples 2-4

Similarly to Application Example 1 except for using biodegradable iron chelate compounds of Table I instead of the iron ethylenediamine-N,N-disuccinate·ammonium complex of Application Example 1, 10% liquid agents were obtained.

[0014]

(Table I)



	生分解性鉄キレート化合物
実施例2	アスパラギン酸-N-モノ酢酸鉄錯体
実施例3	(S)-アスパラギン酸-N-モノプロピオン酸鉄錯体
実施例4	イミノジコハク酸鉄アンモニウム錯体

1. Biodegradable iron chelate compound
2. Application Example 2
3. Application Example 3
4. Application Example 4
5. Aspartic acid-N-monoacetic acid iron complex
6. (S)-aspartic acid-N-monopropionic acid iron complex
7. Iron iminodisuccinate ammonium complex

[0015] Application Example 5 (Preparation of iron aspartic acid-N,N-diacetate chelate hydrate)

A hydrating agent was obtained by sufficiently mixing 10 parts iron aspartic acid-N,N-diacetate·sodium complex, 2 parts sodium alkylbenzenesulfonate, and 88 parts clay.

[0016] Application Examples 6 and 7

Similarly to Application Example 5 except for using biodegradable iron chelate compounds instead of the iron aspartic acid-N,N-diacetate·sodium complex of Application Example 5, 10% hydrating agents were obtained.

[0017]

(Table II)

	生分解性鉄キレート化合物
実施例6	ﾌﾟﾛﾊﾟﾝｼﾞｱﾐﾝ-N,N'-ｼﾞｺﾊｸ酸鉄ｶﾘｳﾑ錯体
実施例7	ｸﾞﾙﾀﾐﾝ酸-N,N'-二酢酸鉄ﾅﾄﾘｳﾑ錯体

1. Biodegradable iron chelate compound
2. Application Example 6
3. Application Example 7
4. Iron propanediamine-N,N′-disuccinate potassium complex
5. Iron glutamic acid-N,N′-diacetate sodium complex

[0018] Test Example 1 and Comparative Example 1 (Spray effect test on grasses)

Sand soils were put into pot of a/5,000, and 3 g chemical fertilizer (15-15-15) as a base fertilizer was mixed with a surface layer of about 10 cm. Kourai grasses cut by a hole cutter with a diameter of 10.5 cm were planted into it and grown in a glass room. After growing for 3 months, an 100-time diluted solution of an iron ethylenediamine-N,N-disuccinate chelate liquid agent was divided into two and sprayed at 15 mL per pot. A test group in which the above-mentioned 100-time diluted solution was not sprayed was an untreated group and was assumed as a comparative example. The test was applied five /4 times in series for the treated group and the untreated group. As a result, the leaf color was darkened in the treated group, compared with the untreated group, and after one month from the treatment, a difference was also recognized in the grass size. The difference of the grass size was shown in Table III.

[0019]

(Table III)

	試験区	草丈 (cm)	根長 (cm)
試験例1	処理区	6.2	24.5
比較例1	無処理区	6.5	11.8

1. Test group

2. Grass size (cm)

3. Root length (cm)

4. Test Example 1

5. Comparative Example 1

6. Treated group

7. Untreated group

[0020] Test Examples 2-7

Similarly to Test Example 1, using the biodegradable iron chelate compounds prepared by Application Examples 2-7, the spray effect on grasses was tested. The results were summarized in Table IV.

[0021]

(Table IV)

	生分解性鉄キレート化合物	草丈 (cm)	根長 (cm)
試験例2	ｱｽﾊﾟﾗｷﾞﾝ酸-N,N'-[illegible]鉄-ﾅﾄﾘｳﾑ錯体	11.8	21.5
試験例3	ｱｽﾊﾟﾗｷﾞﾝ酸-N-ﾓﾉ[illegible]酸鉄錯体	7.7	20.8
試験例4	(S)-ｱｽﾊﾟﾗｷﾞﾝ酸-N-ﾓﾉ[illegible]酸鉄錯体	7.6	20.6
試験例5	ｲﾐﾉｼﾞｺﾊｸ酸鉄ｱﾝﾓﾆｳﾑ錯体	7.1	18.9
試験例6	[illegible]-N,N'-[illegible]酸鉄ｶﾘｳﾑ錯体	7.1	17.0
試験例7	[illegible]酸-N,N'-[illegible]酸鉄ｶﾘｳﾑ錯体	6.9	15.2

1. Biodegradable iron chelate compound

2. Grass size (cm)

3. Root length (cm)

4. Test Example 2

5. Test Example 3

6. Test Example 4

7. Test Example 5

8. Test Example 6

9. Test Example 7

10. Iron aspartic acid-N,N′-diacetate·sodium complex

11. Aspartic acid-N-monoacetic acid iron complex

12. (S)-aspartic acid-N-monopropionic acid iron complex

13. Iron iminodisuccinate ammonium complex

14. Iron propanediamine-N,N′-disuccinate potassium complex

15. Iron glutamic acid-N,N′-diacetate sodium complex

[0022] Test Example 8 and Comparative Example 2 (Water culture test of spinach)

Four sheets of the main leaves of a spinach (kind of product: Taitan) sown in sands were grown and transplanted to a foamed stylol plate in which 8 holes of about 15 mm were uniformly opened, and cultured for 45 days by a NFT method. As a culture solution, a solution with a concentration of 1/2 of a horticulture test prescription was used as a base, and a liquid was supplied to it by a circulating method. A group in which an iron propanediamine-N,N′-disuccinate sodium complex was used at 2 ppm as an iron, and a group in which an ethylenediaminetetracetic acid iron complex was used at 2 ppm was compared as a control group. The culture was carried out in a glass room, and pH of the culture solution was set to 5.0. The culture solution was prepared once per 2 days and renewed at every one week. After applying the test, the biological weight of the ground part and the underground part was measured, and the average value of 8 times in series was adopted, so that results of Table V were obtained. It was confirmed that iron propanediamine-N,N′-disuccinate sodium complex could be substituted as an iron feed agent of the spinach for the ethylenediaminetetracetic acid iron complex.

[0023]

(Table V)

	試験区	地上部 (g/株)	地下部 (g/株)
試験例8	処理区	23.6	18.4
比較例2	対照区	22.9	18.2

1. Test group

2. Ground part (g/plant)

3. Underground part (g/plant)

4. Test Example B

5. Comparative Example 2

6. Treated group

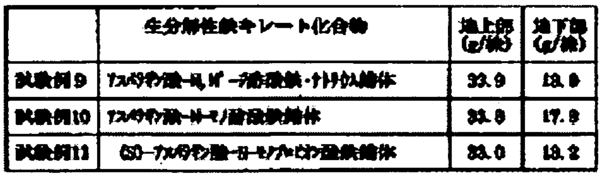
7. Control group

[0024] Test Examples 9-11

Similarly to Test Example 8, using the biodegradable iron chelate compounds prepared by Application Examples 2-4, a water culture test of spinach was tested. The results were summarized in Table V.

[0025]

(Table VI)



	生分解性鉄キレート化合物	地上部 (g/株)	地下部 (g/株)
試験例9	アスパラギン酸-N,N'-ジ酢酸鉄・ナトリウム錯体	33.9	18.0
試験例10	アスパラギン酸-N-モノ酢酸鉄錯体	33.8	17.8
試験例11	(S)-アスパラギン酸-N-モノプロピオン酸鉄錯体	33.0	18.2

1. Biodegradable iron chelate compound

2. Ground part (g/plant)

3. Underground part (g/plant)

4. Test Example 9

5. Test Example 10

6. Test Example 11

7. Iron aspartic acid-N,N′-diacetate·sodium complex
8. Aspartic acid-N-monoacetic acid iron complex
9. (S)-aspartic acid-N-monopropionic acid iron complex

[0026]

(Effects of the invention)

Since the iron chelate compound of the present invention has biodegradability, not only crop plants absorb iron and do not remain in the environment, but the growth of the crop plants is accelerated by applying the compound to the crop plants or soil, so that physiological damages ascribed to an iron deficiency can be prevented or lightened. Thus, the present invention is industrially very useful.